932,792

PATENT SPECIFICATION

DRAWINGS ATTACHED

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International Classification:—B62g.

COMPLETE SPECIFICATION

Improvements in or relating to the Manufacture of Pneumatic Tyres

We, DUNLOP RUBBER COMPANY LIMITED, a British Company, of 1, Albany Street, London, N.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method and an apparatus for assembling and shaping a pneumatic tyre.

In the manufacture of pneumatic tyres of the type in which a tread reinforcement (or "breaker") having considerable rigidity in directions transverse to the mid-circumferential plane of the tyre is provided, it is necessary to ensure that the layers of cords comprising the breaker are placed, during assembly of the tyre, symmetrically with respect to the circumferential centre line of the tyre carcass.

The present invention provides a method and an apparatus for shaping a tyre carcass from cylindrical to toroidal form and for supporting a breaker or tread or both in a position symmetrically surrounding the carcass so that the carcass is shaped into contact therewith, the breaker being accurately positioned, in the shaped carcass, symmetrically with respect to the circumferential centre line of the carcass.

According to the invention, a method for assembling and shaping a pneumatic tyre comprises mounting a cylindrical tyre carcass on an inflatable shaping unit having a pair of bead supporting members and means for moving said members towards or away from one another by equal amounts in relation to the mid-circumferential plane of symmetry of the shaping unit, securing a breaker or a tread or both to an annular carrying means, relatively axially moving the annular carrying means supporting the breaker or tread or both and the shaping unit so that the carrying means and the shaping unit are disposed with the carrying means coaxially surrounding the shaping unit with the carcass and breaker or tread or both symmetrically disposed in relation to one another, and inflating the shaping unit to shape the carcass into the breaker or the tread or both.

According to the invention also, apparatus for assembling and shaping a pneumatic tyre comprises an inflatable shaping unit, for supporting and shaping a cylindrical tyre carcass, having a pair of bead supporting members and means for moving said member towards and away from one another by equal amounts in relation to the mid-circumferential plane of symmetry of the shaping unit, and a carrying means said carrying means and shaping unit being relatively movable axially in relation to one another to move a breaker or tread or both secured within the carrying means in the form of an annulus into a position in which the breaker or tread or both is symmetrically disposed in relation to a carcass supported by the shaping unit.

The shaping unit may comprise an inflatable flexible diaphragm secured at its ends to the bead supporting members, or a diaphragm-less construction may be employed, the bead supporting members each being provided with an inflatable annular bag for sealing engagement with an associated bead of a tyre carcass.

The carrying means preferably comprises a rigid cylindrical annulus, having gripping means in the form of an inflatable cylindrical diaphragm secured to its inner surface. The

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annulus may be mounted on a framework which is movable axially with respect to the drum and the shaping unit.

Preferably, a collapsible drum is located, coaxially with the shaping unit, for building or supporting a breaker or a tread or both to be subsequently transferred to the shaping unit by the carrying means.

Various embodiments of the invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a side view of apparatus for assembling parts of and shaping pneumatic tyres, shown partly in cross-section i.e. along the line I—I of Figure 2 and with certain features omitted for clarity.

Figure 2 is an end view of the apparatus shown in Figure 1;

Figure 3 is a cross-sectional view of part of a carrying ring shown in Figures 1 and 2 together with an auxiliary carrying ring;

Figure 4 is an axial cross-sectional view of a part of a modified construction incorporating an annular bead-sealing tube.

Figures *5a, 5b, 5c, 5d, 5e,* and *5f* are diagrams showing the sequence of operations of the apparatus shown in Figures 1 and 2;

Figures *6a, 6b, 6c, 6d, 6e* and *6f* are diagrams showing the sequence of operations of the apparatus shown in Figures 1 and 2 together with that shown in Figure 3.

The machine shown in Figures 1 and 2 comprises a machine frame 1 which carries in bearings 2 and 3 a rotatable tubular shaft 4. The shaft 4 is drivable by means of an electric motor and a chain drive (not illustrated) connected to a sprocket *4a* attached to the shaft 4.

The shaft 4 is provided with a flange 5 to which is bolted a second flange 6 attached to a tubular shaft 7 which forms a rotatable supporting shaft for a shaping unit 8.

The shaping unit 8 comprises a pair of bead supporting members 9 and 10 carried on end plates 11 and 12 respectively, a cylindrical rubber diaphragm 13 being air-tightly secured at its ends to the end plates 11 and 12. The bead supporting member 10 is detachably secured to the end plate 12 by means of bayonet studs *12a* fixed in the end plate 12 and a flange *10a* attached to the member 10 which is provided with slots *10b* for engagement with the studs *12a* (see Figure 2).

The diaphragm 13 is inflatable via an inflation valve (not shown), the end plates 11 and 12 being simultaneously movable together or apart by equal amounts with respect to the mid-circumferential plane of symmetry (indicated by centre line X—X) of the shaping unit by hydraulic means with use of the following apparatus:—

The end plate 11 is mounted on a sleeve 14 which is coaxial with the shaft 7 and axially slidable on bearings 15 and 16 fixed to the shaft 7, the bearing 16 being provided with a sealing ring 17. The sleeve 14 extends beyond the bearing 16 and has a flange 18 provided with a sealing ring 19 attached to its end to form a fluid-tight annular chamber 20 between the bearing 16 and the flange 18. The chamber 20 is provided with an aperture 21 in the wall of the tubular shaft 7 to which is connected a flexible pipe 22.

The end plate 12 is supported on a cylindrical member 23 carried on a plate 24 attached to a shaft 25 by a bush 26 fixed to the plate 24 and attached to the shaft 25 by means of a key 27 and a clamping ring 28 in screw-threaded engagement with the shaft 25. A sealing ring 29 is provided between the shaft 25 and the bush 26. The shaft 25 is supported coaxially within the shaft 7 by a bearing 30 carried in an end plate 31 attached to the shaft 7, and by a bearing 32 attached to the flange 5. The bearings 30 and 32 are provided with sealing rings 33 and 34 respectively.

A piston 35, slidable axially within the shaft 4 and in fluid-tight engagement therewith, is attached to the end *25a* of the shaft 25. A passageway 36 drilled in the piston communicates with an annular fluid tight chamber 37 formed between the piston 35, the shaft 4 and the flange 5. The chamber 37 is connected, via a hole 38 drilled through the bearing 32 and the flexible pipe 22 to the chamber 20 described above. The passageway 36 is also connected by a coupling 39 to an end of a flexible pipe 40 which is connected at its other end to a rotatable gland 41 attached to the shaft 4. Member 42 is the non-rotatable element of the gland. The gland 41 is also provided with a pipe (not illustrated) connected to the cylinder 43 formed by the interior of the shaft 4, closed at one end by the piston 35 and at the other end by the gland 41. A valve (not illustrated) is provided for supplying fluid under pressure either to the pipe 40 or to the cylinder 43 via the gland 41.

In Figure 1, the bead supporting members 9 and 10 are shown spaced-apart from one another to their maximum-extent. When fluid under pressure is supplied via the pipe 40 to the chambers 37 and 20, the pressure within the chamber 20 acts to move the sleeve 14 (carrying the end plate 11) to the right (as seen in Figure 1) and the pressure within the chamber 37 acts to move the shaft 25 (carrying the end plate 12) to the left.

In order to ensure that the bead supporting members 9 and 10 are moved together by equal amounts by the apparatus just described, a pair of rack and pinion mechanisms 44, in diametrically opposed positions relative to the axis of the shaping unit, are provided within

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the shaft 7 to couple the end plates together positively.

Each rack and pinion mechanism 44 (only one of which is shown in Figure 1) comprises a pinion 45 rotatably supported by a bracket 46 attached to the shaft 7. A rack 47 is attached to the sleeve 14 by a bracket 48 extending through a slot in shaft 7 and extends axially of the shaping unit 8, meshing with the pinion 45. A rack 49 is fixed to the shaft 25 and also extends axially of the shaping unit, meshing with the pinion 45.

In order to move the bead supporting members 9 and 10 apart, fluid under pressure may be admitted, via the valve provided, to the cylinder 43, the fluid in the chambers 37 and 20 being simultaneously allowed to escape. The piston 35 is thus forced to the right as seen in Figure 1, carrying with it the shaft 25 and hence the supporting member 10. Simultaneously, the supporting member 9 is automatically moved to the left by the action of the two rack and pinion mechanisms 44.

In order to limit the extent to which the supporting members 9 and 10 may be moved together, three adjustable stops are provided for engagement with the flange 18 attached to the sleeve 14, the stops comprising steel rods 50, equally spaced-apart on a common pitch circle, the rods 50 being in screw-threaded engagement with screw-threaded holes 51 in the plate 24. The rods 50 are provided with hexagonal ends 50*b* and locknuts 50*c* and are adjustable so that their ends 50*a* are in a predetermined axial position relative to the shaping unit. Stops (not illustrated) are also provided to limit the extent to which the supporting members 9 and 10 may be moved apart.

A collapsible rotatable drum 52 is mounted on the machine frame 1 coaxially with the shaping unit 8. The drum 52 comprises a cylindrical body portion 53 attached by means of a flange 54 to a rigid annular supporting plate 55 fixed to the machine frame 1. A rotatable annular member 56 is supported on bearings 57 and 58 on the body portion 53 and is drivable by means of a gear ring 59 attached to the annulus 56 and engageable by a pinion attached to the shaft of an electric motor (neither of which are illustrated). A pair of side plates 60 and 61 are fixed one to each side of the annulus 56 to locate axially an inflatable annular bag 62 surrounded by a plurality of segments 63, the segments 63 forming a substantially continuous cylindrical surface in the deflated state of the bag 62. The bag 62 is inflatable via an inflation valve (not shown) to move the segments 63 radially outwardly of the drum 52 from the collapsed position shown in Figure 1 to a position in which they contact stops 60*a* and 61*a* formed on the side plates 60 and 61 respectively. A thick rubber annulus 64 is provided to surround the segments 63 and form a smooth unbroken surface in both the collapsed and the expanded states of the drum 52.

A pair of parallel rails 65 and 66, one on each side of the machine frame 1 and both rails being parallel to the axis of the shaping unit and the collapsible drum, is provided for axially movably supporting a pair of frameworks 67 on which a carrying ring 68 is fixed. Each framework 67 carries three grooved wheels 69, 70, 71, the wheels 69 running on the lower surfaces of the rails 65 and 66 and the wheels 70 and 71 running on the upper surfaces of the rails so that the frameworks 67 may be moved along the rails without danger of tilting the carrying ring 68.

A linkage 72 is provided for moving the frameworks 67 and thus the carrying ring 68 from a position in which the carrying ring is disposed around the collapsible drum 52 to a position in which the ring 68 is disposed around the shaping unit 8. The linkage 72 comprises links 73 and 74, the link 73 being fixed by a pivot 73*a* to a bracket 75 axially adjustably fixed to the rail 65, and the link 74 being fixed to the framework 67 associated with the rail 65 by a pivot 74*a*. The links 73 and 74 are pivotally connected together by a pin (not shown) provided with a handle 76. The link 74 is formed from two parallel horizontally spaced-apart members 74*b* (only one of which is seen in the side view shown in Figure 1). The link 73 is provided with a turn buckle 77 and locknuts 78 and 79 for adjusting its length.

The operation of the linkage 72 to move the frameworks 67 and carrying ring 68 is effected by rotating the link 73 about the pivot 73*a* in an anticlockwise direction as seen in Figure 1, through 180°, the members 74*b*, forming the link 74, lying one on each side of the link 73 in the final position of the linkage 72. The linkage 72 is set by adjustment of the position of the bracket 75 and by adjustment of the turnbuckle 77 so that the two positions of the linkage correspond to positions of the carrying ring 68 in which the ring 68 is disposed symmetrically about the centre line X—X of the shaping unit 8, as shown in Figure 1, and symmetrically about the centre line Y—Y of the drum 52. Thus the linkage 72 serves to accurately locate the carrying ring 68 in predetermined axially-spaced-apart positions, i.e. symmetrical with centre lines X—X and Y—Y.

The carrying ring 68 comprises a rigid cylindrical annulus 80 strengthened by radially extending flanges 81 and 82. On its inner surface, the annulus 80 carries a rubber diaphragm 83 air-tightly attached to the annulus 80 by side portions 83*a* and 83*b* of the diaphragm which are folded around the edges of the annulus and secured to its outer surface by metal bands 84 and 85 fixed tightly around the circumference of the annulus 80.

The diaphragm 83 is inflatable via an

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inflation valve (not shown). A handle 86 is attached to the annulus 80 to assist axial movement thereof by the linkage 72.

The flange 62 carries six bayonet studs 87, secured to the flange 82 by integral screw-threaded portions 87*a* and nuts 88 (see Figure 3), fixed in equally-spaced positions around the ring 68. Figure 3 illustrates the use of the studs 87 to support an auxiliary carrying ring 89 having a diaphragm 89*a* similar to the diaphragm 83. The ring 89 is of similar construction to the ring 68, except that it is of smaller diameter and carries six brackets 90 having bayonet slots 91 for engagement with the studs 87 on the ring 68. This arrangement enables the auxiliary ring 89 to be held rigidly within the ring 68 and thus supported to accurately symmetrically surround either the centre line X—X of the shaping unit 8 or the centre line Y—Y of the drum 52.

The machine shown in Figures 1—3 also comprises the following ancillary apparatus (see Figure 2):—

A tread strip supplier 92 is located adjacent the collapsible drum 52 so that an unvulcanised tread strip may be supplied thereby to a built-up breaker supported on the drum. The tread strip supplier comprises a roller conveyor 93 having freely rotatable conveyor rollers 94 and a larger diameter roller 95 for pressing a tread strip into contact with a breaker supported on the drum 52. The conveyor 93 is attached by a pivot 96 to a bracket 97 fixed to the machine frame 1, and the roller 95 is movable towards the drum 52 by pivotal movement of the conveyor 93 about the pivot 96, this movement being produced by the use of a pneumatic piston and cylinder 98 attached to the conveyor by a pivot 99 and by a pivot 100 to a support 101 fixed to the bracket 97.

Pairs of tread and sidewall stitches 102 and 103 are located adjacent to the shaping unit 8 on a supporting framework 104. The stitchers 102 and 103 (only one of which is shown, in each case, in Figure 2) are operable to consolidate tread and sidewalls of a built-up tyre on the shaping unit 8.

One modification which may be made to the shaping unit 8 is illustrated in Figure 4. In place of the cylindrical rubber diaphragm 13, a pair of bead supports 105 is provided, each bead support 105 having an inflatable annular bag 106 supported on a flange 107 having a smaller radius than the bead seating portion 108 of the bead support 105. The annular bag 106 is secured to a portion 109 of the flange 107 by an adhesive, and is provided with an inflation pipe 110. When a tyre carcass is placed on the shaping unit with its beads in engagement with the seats 108, the bags 106 are inflated to engage and form a fluid-tight seal with the inner surface of the bead region of the carcass and thus inflation of the shaping unit is enabled to take place without the provision of a rubber diaphragm.

One method of operation of the machine illustrated in Figures 1 and 2 is illustrated diagrammatically in Figures 5*a*, 5*b*, 5*c*, 5*d*, 5*e* and 5*f*.

Figure 5*a* shows a tyre carcass 111 in position on the shaping unit 8, its beads 112 and 113 being supported by the bead supporting members 9 and 10 respectively, the diaphragm 13 being deflated and the members 9 and 10 at their maximum distance apart. A breaker 114 comprising two layers 115 and 116 of rubberised parallel steel cord fabric is built on the drum 52, in the expanded state of the drum, by laying strips of said fabric one at a time on the drum and rotating the drum to take up each strip. A tread 117 is similarly applied to the drum, superimposed on the breaker 114. The carrying ring 68 is then moved by the linkage 72 to the position shown in Figure 5*a*.

The diaphragm 83 attached to the carrier ring 68 is then inflated (see Figure 5*b*) to grip the tread and breaker assembly on the drum 52. The drum 52 is then collapsed, leaving the breaker and tread assembly supported in the carrier ring 68.

The carrier ring 68 is then moved to position the breaker and tread assembly symmetrically around the centre line X—X of the shaping unit 8 (see Figure 5*c*).

The shaping unit 8 is then inflated to force the diaphragm 13 radially outwardly and thus to shape the carcass 111 into the breaker and tread assembly. At the same time, fluid pressure is applied to the chambers 20 and 37 to force the bead supporting members 9 and 10 together, the rack and pinion mechanisms 44 ensuring that the members 9 and 10 move by equal amounts towards the centre line X—X (see Figure 5*d*). The diaphragm 83 is now deflated and the carrier ring 68 is moved away from the shaping unit 8 (see Figure 5*e*). The tread and sidewall stitches are then operated, the shaping unit 8 being rotated by the rotatable shaft 7, to consolidate the read and sidewalls of the tyre.

The inflation pressure is now released from the interior of the shaping unit 8 and the supporting members 9 and 10 are simultaneously moved apart and the diaphragm 13 extracted from the tyre (see Figure 5*f*) by releasing the fluid pressure from the chambers 20 and 37 and applying fluid pressure to the cylinder 43. The piston 35 is thus forced back to the position shown in Figure 1, the supporting member 10 being carried outwardly by the shaft 25 and the supporting member 9 being correspondingly moved by the action of the rack and pinion mechanism 44.

The shaped tyre may now be removed for vulcanisation by removal of the detachable bead support 10.

The operations described above for building

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a two-layer breaker on the collapsible drum are also applicable to the building of breakers having one layer, or three or more layers. In the case of a three-layer breaker in which the innermost layer has cords disposed at a high angle (e.g. 60° to 90°) to a circumferential line of the breaker, and in which the other layers have cords disposed at low angles (e.g. 20°) to said circumferential line, it has been found to be advantageous to build the innermost layer on the drum in the collapsed state thereof and subsequently to expand the drum before adding the other layers. This procedure ensures that the innermost layer is held firmly by the drum and is not distorted during the application of the overlying layers.

An alternative method of operation of the apparatus shown in Figures 1 and 2, and using the auxiliary carrier ring 89, shown in Figure 3, is illustrated in Figures *6a*, *6b*, *6c*, *6d*, *6e* and *6f*.

The auxiliary carrier ring 89 is placed on a horizontal surface 119 with its diaphragm *89a* deflated and a breaker layer 118 is placed inside the diaphragm. The diaphragm *89a* is then inflated to grip the layer 118, as shown in Figure *6a*. The layer 118 may be of the form described in the specification of our co-pending United Kingdom Patent Application No. 29912/57 (Patent No. 894,706) or may be of the form described in the specification of our United Kingdom Patent No. 808,341, the auxiliary carrier ring 89 being particularly useful in manipulating breakers of these forms.

A carcass 120 is fitted to the shaping unit 8 as described in the case of the method illustrated in Figures *5a*, *5b*, *5c*, *5d*, *5e* and *5f*, and a layer 121 of rubberised parallel-cord fabric, the cords of the layer making a large angle, e.g. 60°—90°, with a circumferential line of the layer, is built on the collapsed drum 52 (see Figure *6b*). The auxiliary carrying ring 89 is then fitted in position within the carring ring 68 by the bayonet studs 87 and slots 91 described above.

The two carrier rings are then moved to a position symmetrically surrounding the drum 52 (see Figure *6c*) and the drum is expanded to press the breaker layer 121 into contact with the layer 118 carried by the carrier ring 89.

The diaphragm *89a* is then deflated and the carrier rings moved away from the drum 52. The ring 89 is then removed from the ring 68, and a tread 122 is applied to the breakers 121 and 118 on the drum 52 (see Figure *6d*).

The carrier ring 68 is now moved back into position around the drum 52 to pick up the completed breaker and tread assembly by inflating the diaphragm 83 and collapsing the drum 52 (see Figure *6e*).

The carrier ring 68 is now moved to a position surrounding the shaping unit 8, and the diaphragm 13 inflated to shape the carcass into contact with the breaker and tread assembly. The remaining operations to produce the finished tyre are performed in a similar manner to that described above in relation to Figures *5a*, *5b*, *5c*, *5d*, *5e* and *5f*.

Although in the apparatus described the bead supporting members are movable together or apart by means of fluid pressure, equivalent mechanical means for moving the members together or apart by equal amounts may be substituted, such as a shaft passing axially through the supporting members and having right- and left-hand screw threads for engagement with corresponding screw-threaded holes in the end plates carrying the supporting members, the end plates being prevented from rotating by a fixed shaft or shafts parallel to the axis of the shaping unit and passing slidably through apertures in the end plates.

Although an auxiliary carrying ring having pneumatic means for gripping a breaker is used in the apparatus described, a rigid segmented ring may be used either in association with the carrying ring described or with an axially movable jig for positioning the ring accurately with respect to a tyre carcass supported on the shaping unit.

In this instance, the breaker would normally be built up inside the ring, the ring placed on the jig and the carcass shaped into contact with the breaker. A tread would then be fitted to the carcass and breaker assembly on the shaping unit.

WHAT WE CLAIM IS:—

1. A method for assembling and shaping a pneumatic tyre comprising mounting a cylindrical tyre carcass on an inflatable shaping unit having a pair of bead supporting members and means for moving said members towards or away from one another by equal amounts in relation to the mid-circumferential plane of symmetry of the shaping unit, securing a breaker or a tread or both to an annular carrying means, relatively axially moving the annular carrying means supporting the breaker or tread or both and the shaping unit so that the carrying means and the shaping unit are disposed with the carrying means coaxially surrounding the shaping unit with the carcass and breaker or tread or both symmetrically disposed in relation to one another, and inflating the shaping unit to shape the carcass into the breaker or the tread or both.

2. A method for assembling and shaping a pneumatic tyre comprising mounting a cylindrical tyre carcass on an inflatable shaping unit having a pair of bead supporting members and means for moving said members towards or away from one another by equal amounts in relation to the mid-circumferential plane of symmetry of the shaping unit, placing a breaker or a tread or both on a collapsible drum disposed coaxially relative to the shaping unit, locating an annular carry-

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ing means coaxially with the drum and the former, relatively axially moving the annular carrying means and the drum so that the carrying means and the drum are symmetrically disposed in relation to one another with the carrying means coaxially surrounding the drum, securing the breaker or the tread or both to the carrying means by gripping means thereon, collapsing the drum and relatively axially moving the carrying means supporting the breaker or tread or both and the shaping unit so that the carrying means and the shaping unit are disposed with the carrying means coaxially surrounding the shaping unit with the carcass and breaker or tread or both symmetrically disposed in relation to one another, and inflating the shaping unit to shape the carcass into the breaker or the tread or both.

3. A method according to Claim 2 for assembling and shaping a pneumatic tyre having a breaker comprising a layer of cords disposed at a high angle to the mid-circumferential line of the breaker and having an additional layer or layers comprising cords disposed respectively at a low angle or at low angles with respect to the mid-circumferential line of the breaker, comprising placing the layer of chords having a high angle with respect to the mid-circumferential line of the breaker on the drum, said drum being in a collapsed state, expanding the drum and subsequently adding the additional layer or layers.

4. Apparatus for assembling and shaping a pneumatic tyre comprising an inflatable shaping unit, for supporting and shaping a cylindrical tyre carcass, having a pair of bead supporting members and means for moving said members towards and away from one another by equal amounts in relation to the mid-circumferential plane of symmetry of the shaping unit, and a carrying means, said carrying means and shaping unit being relatively movable axially in relation to one another to move a breaker or tread or both secured within the carrying means in the form of a single annulus, into a position in which the breaker or tread or both is symmetrically disposed in relation to a carcass supported by the shaping unit.

5. Apparatus for assembling and shaping a pneumatic tyre comprising an inflatable shaping unit, for supporting and shaping a cylindrical tyre carcass, a collapsible drum disposed coaxially with the inflatable shaping unit for supporting a breaker a breaker or a tread or both, a carrying means for carrying a breaker or a tread or both in the form of a single annulus relatively axially movable in relation to the collapsible drum and the shaping unit between a position in which is coaxially surrounds and is symmetrically positioned in relation to the drum and a position in which it coaxially surrounds and is symmetrically disposed in relation to a carcass supported by the shaping unit in its deflated state, and means for accurately locating the said position of the annular carrying means relative to the shaping unit.

6. Apparatus according to Claim 5 wherein the carrying means comprises a rigid annulus having gripping means for supporting a breaker or tread or both therein.

7. Apparatus according to Claim 6 wherein the rigid annulus is cylindrical in form and carries gripping means in the form of an inflatable cylindrical diaphragm disposed on the inner surface of the annulus.

8. Apparatus according to any Claim 5 to 7 wherein the carrying means is mounted on a framework movable axially with respect to and between the drum and the shaping unit.

9. Apparatus according to Claim 8 wherein a linkage is provided for moving the carrying means, said linkage comprising a pair of links, one link being pivotally attached to the framework, the other link being pivotally attached to a rigid member in a fixed axial position relative to the drum and to the shaping means, and the two links being pivotally connected together.

10. Apparatus according to Claim 9 wherein means are provided for adjusting the length of one of the links.

11. Apparatus according to any of Claims 4 to 10 wherein the inflatable shaping unit comprises a flexible diaphragm for shaping a cylindrical tyre carcass to toroidal shape.

12. Apparatus according to any of Claims 4 to 10 wherein each of the bead supporting members comprises an inflatable annular bag for sealing engagement with an associated bead of a tyre carcass.

13. Apparatus according to any of Claims 4 to 12 wherein the means for moving the bead supporting members towards and away from one another by equal amounts in relation to the mid-circumferential plane of symmetry of the shaping unit comprises a hydraulic means, said members being coupled together by means of a pair of axially extending racks one attached to each member and a pinion in engagement with both racks and supported in a fixed axial position relative to the mid-circumferential plane of symmetry of the shaping unit.

14. A method for assembling and shaping a pneumatic tyre substantially as described herein.

15. A method for assembling and shaping a pneumatic tyre substantially as described herein and illustrated in Figures *5a*, *5b*, *5c*, *5d*, *5e*, and *5f* of the accompanying drawings.

16. A method for assembling and shaping a pneumatic tyre substantially as described herein and illustrated in Figures *6a*, *6b*, *6c*, *6d*, *6e*, and *6f*, of the accompanying drawings.

17. Apparatus for assembling and shaping

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a pneumatic tyre constructed and arranged substantially as described herein and shown in Figures 1 and 2 of the accompanying drawings.

18. Apparatus for assembling and shaping a pneumatic tyre constructed and arranged substantially as described herein and shown in Figures 1, 2 and 3 of the accompanying drawings.

19. Apparatus for assembling and shaping a pneumatic tyre constructed and arranged substantially as described herein and shown in Figures 1 and 2, modified to incorporate bead supports as illustrated in Figure 4, of the accompanying drawings.

20. A pneumatic tyre assembled and shaped by a method as claimed in any of Claims 1 to 3 and 14 to 16.

21. A pnematic tyre assembled and shaped by means of the apparatus as claimed in any of Claims 4 to 13 and 17 to 19.

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Agent for the Applicants.

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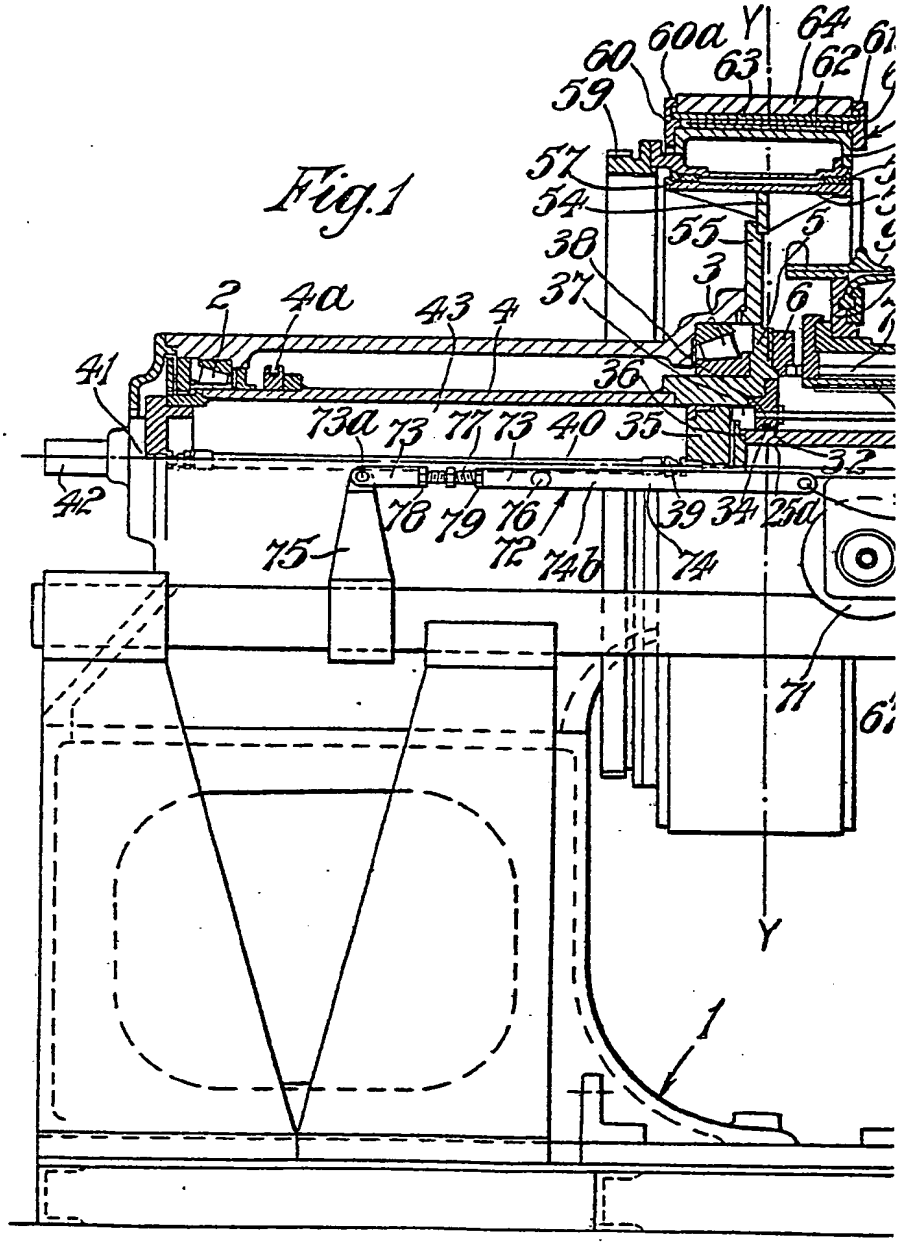
Fig.1



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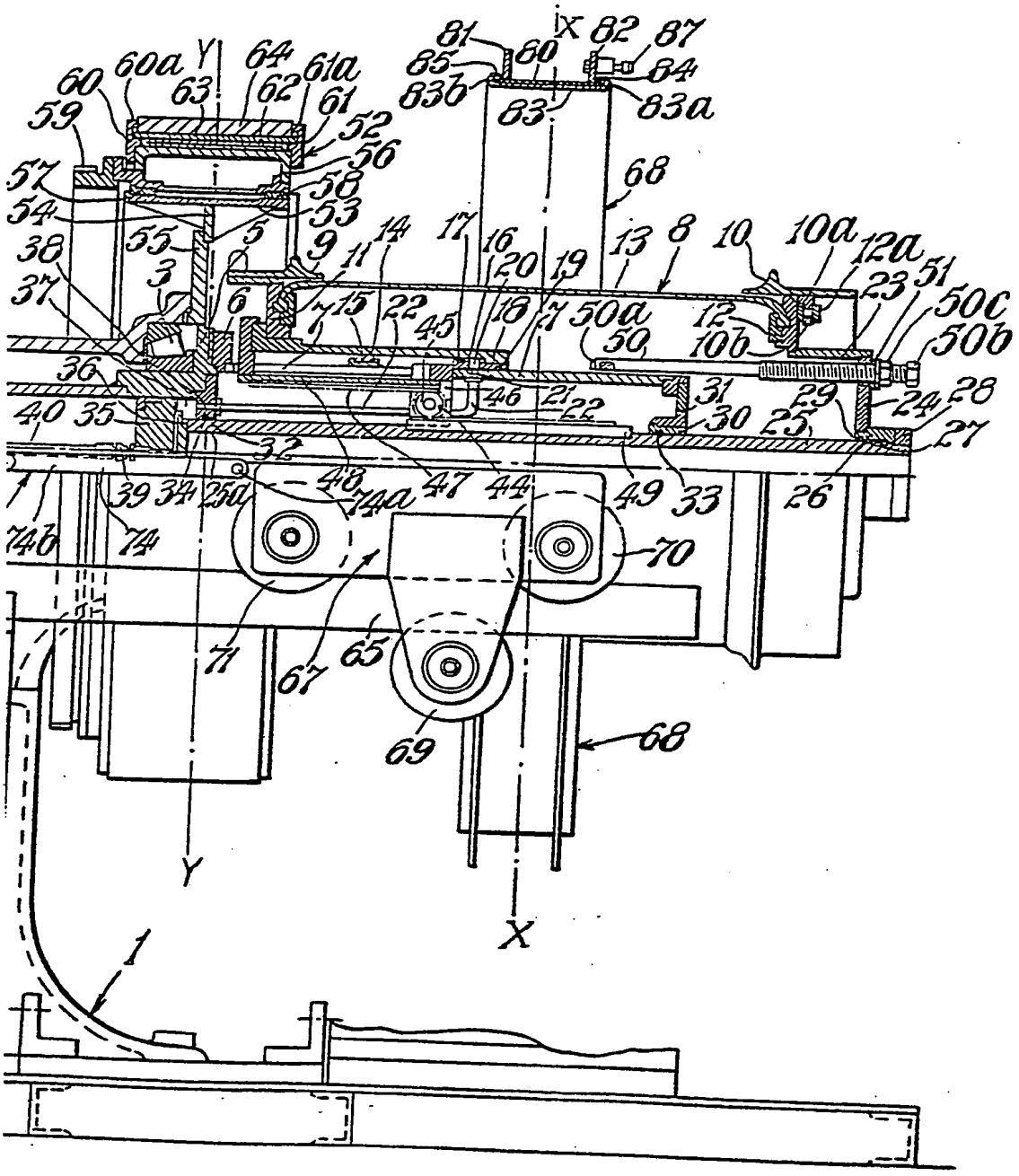

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Fig.1

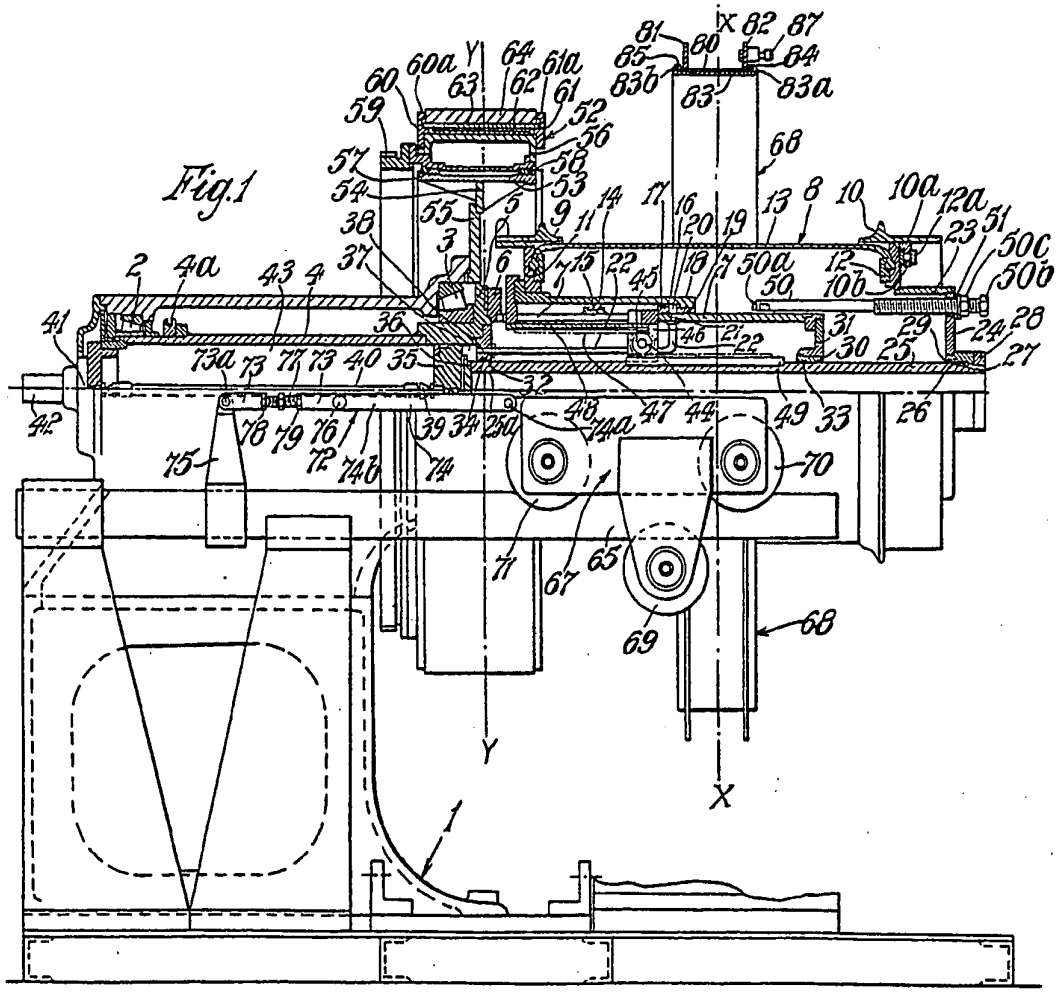
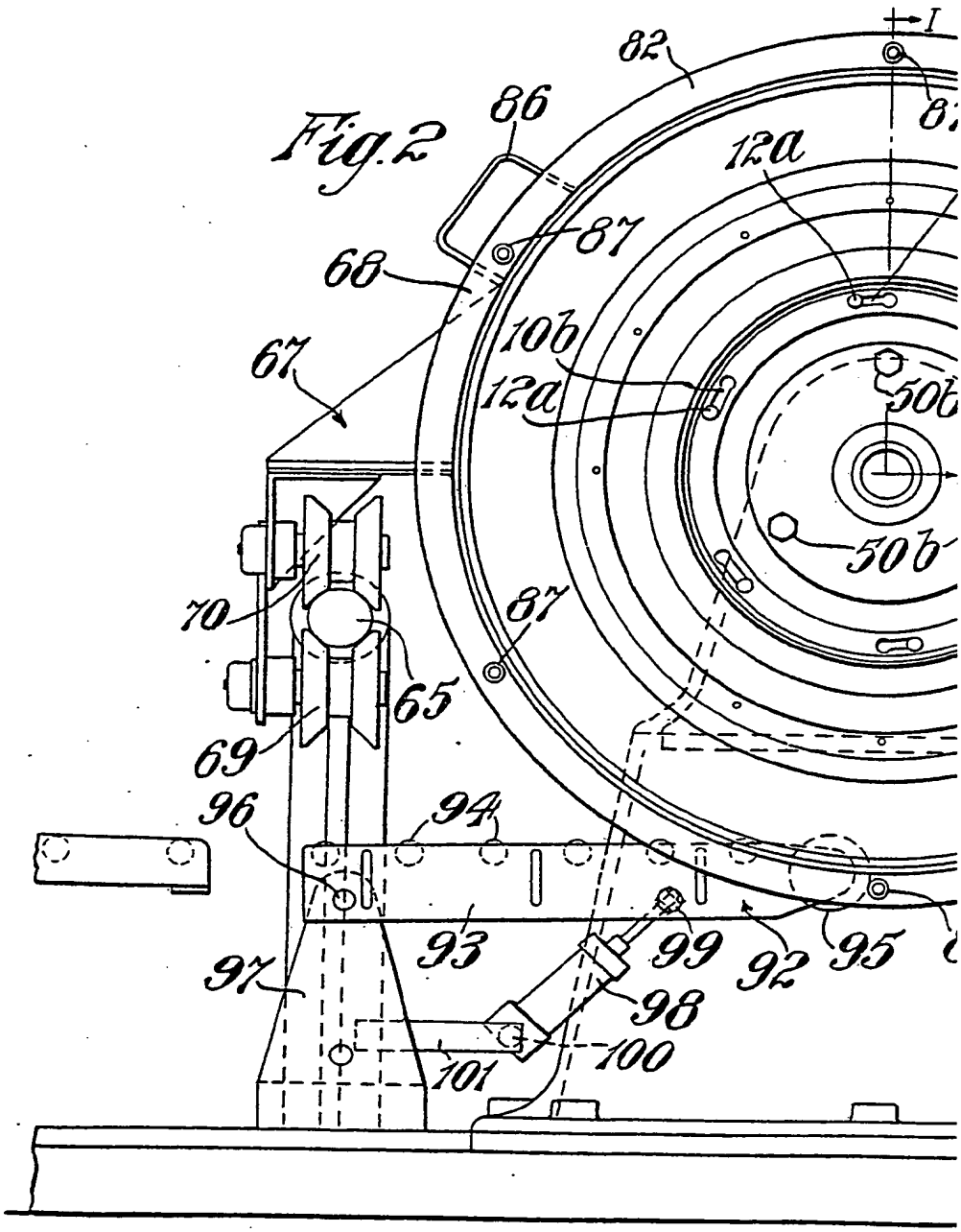


Fig. 2



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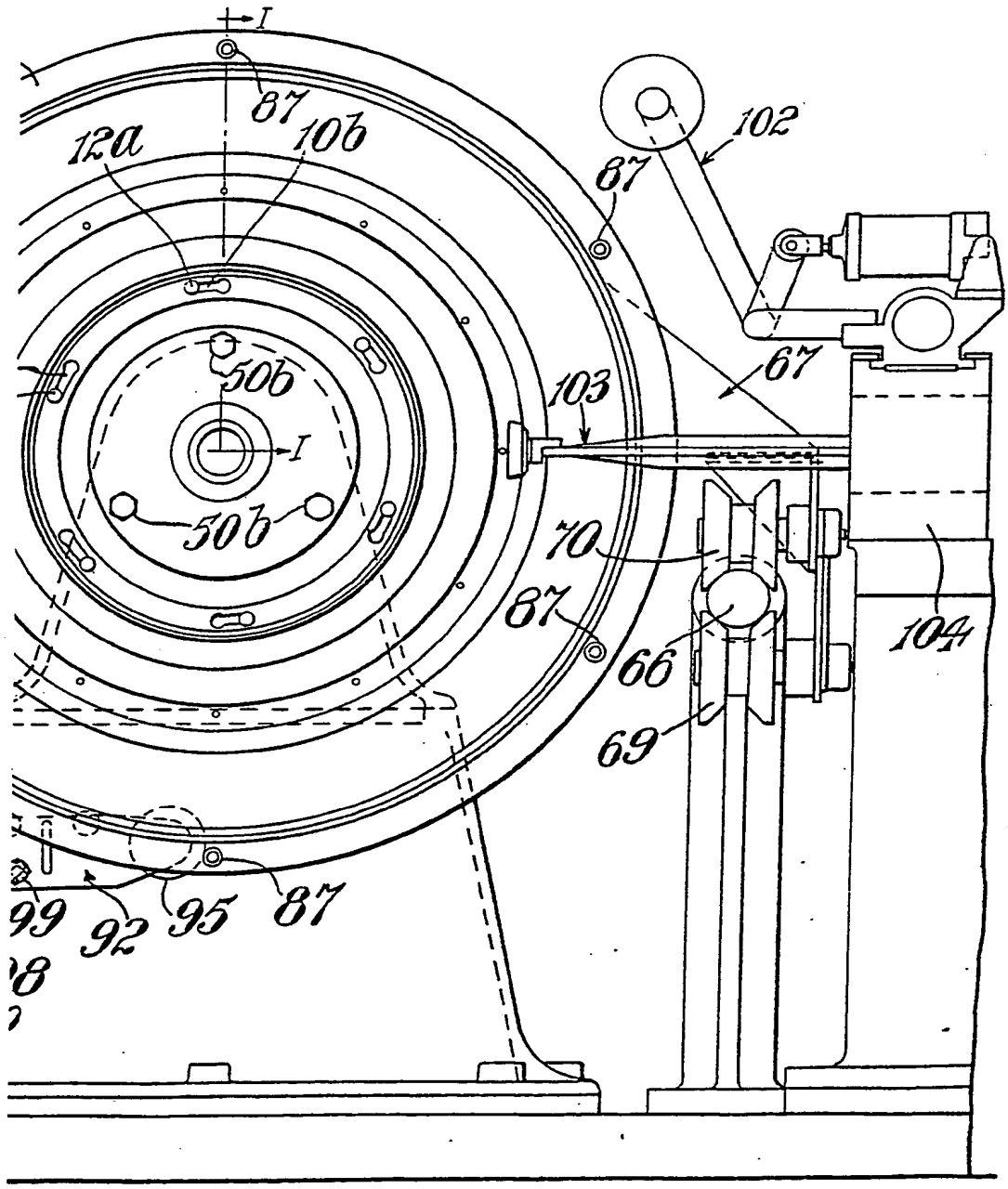

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Sheet 2

Fig.2

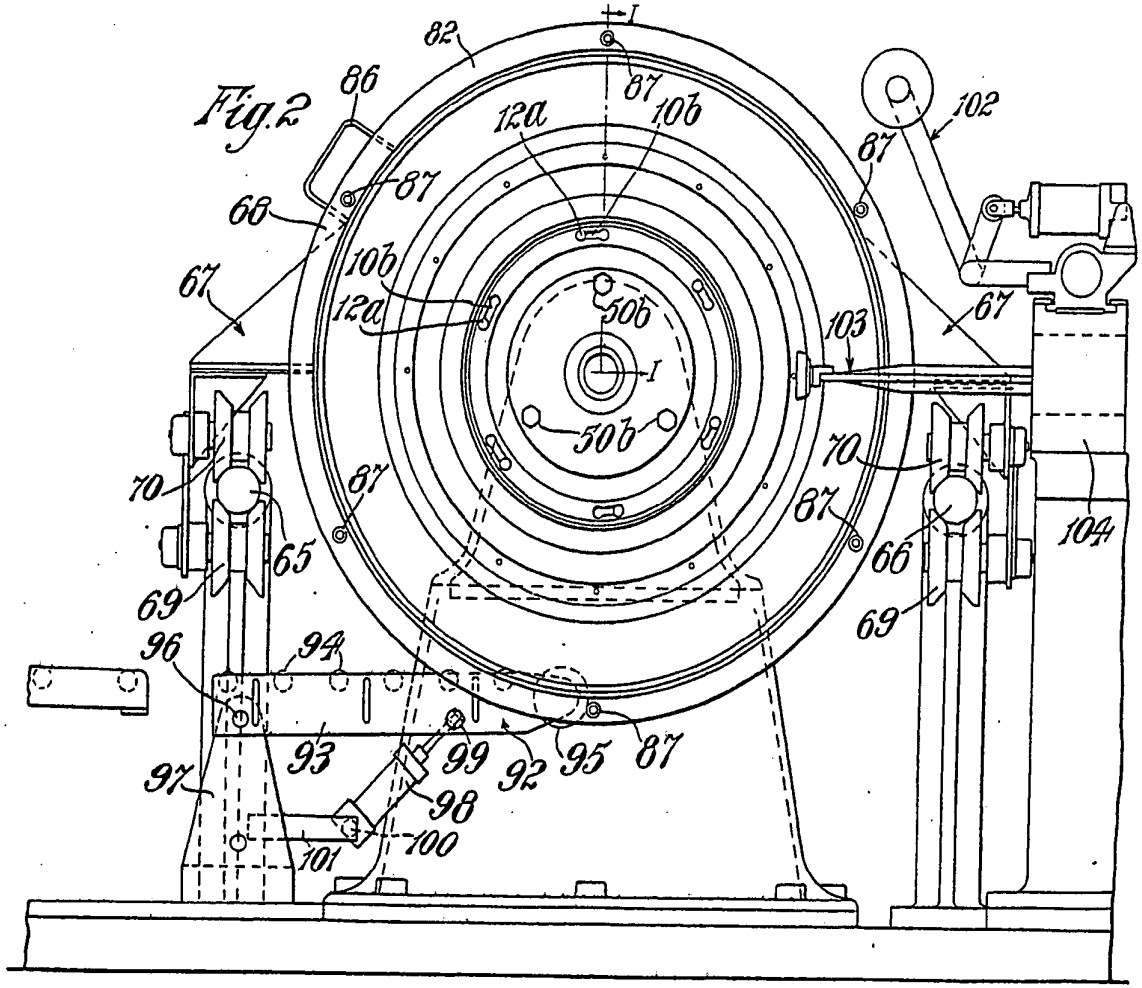


Fig. 3

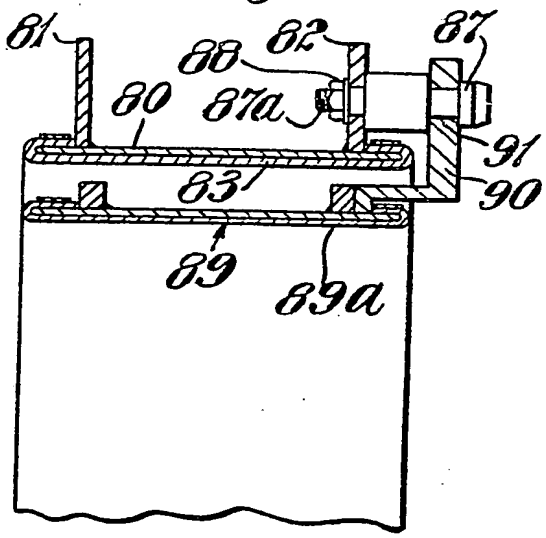
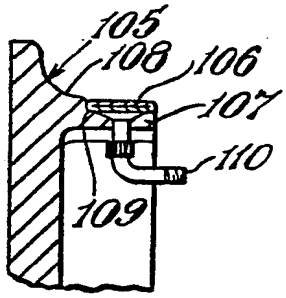


Fig. 4



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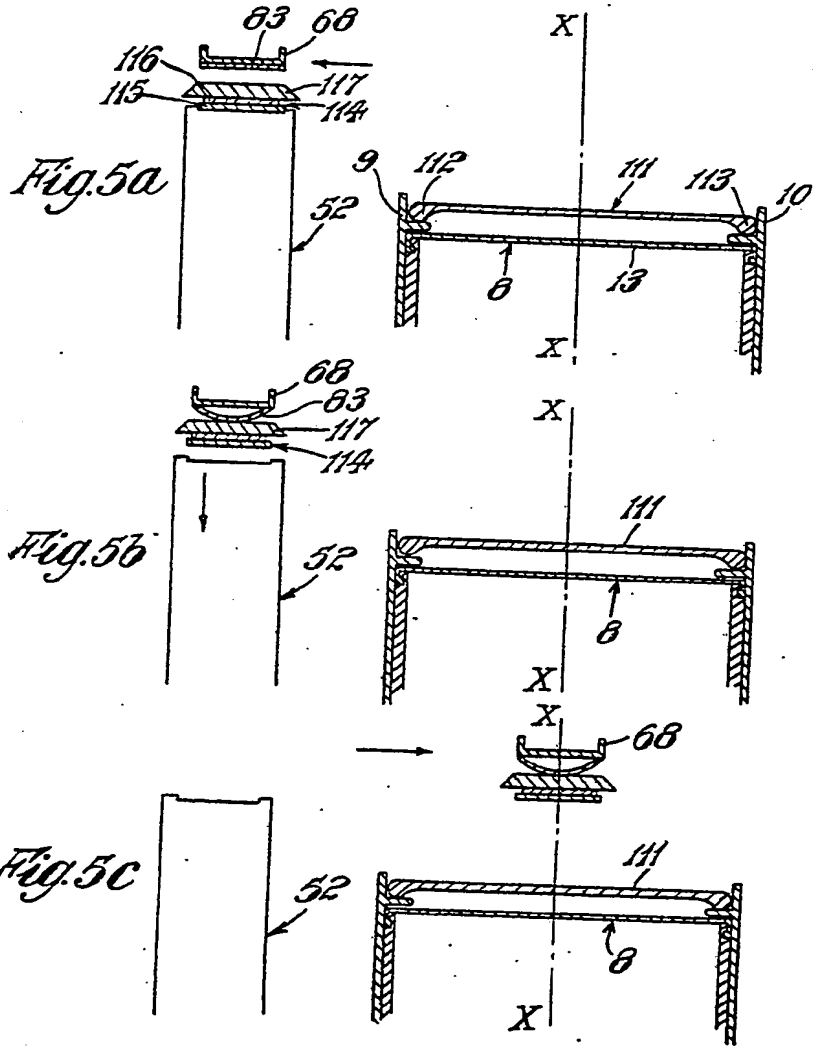

Fig.5a

Fig.5b

Fig.5c

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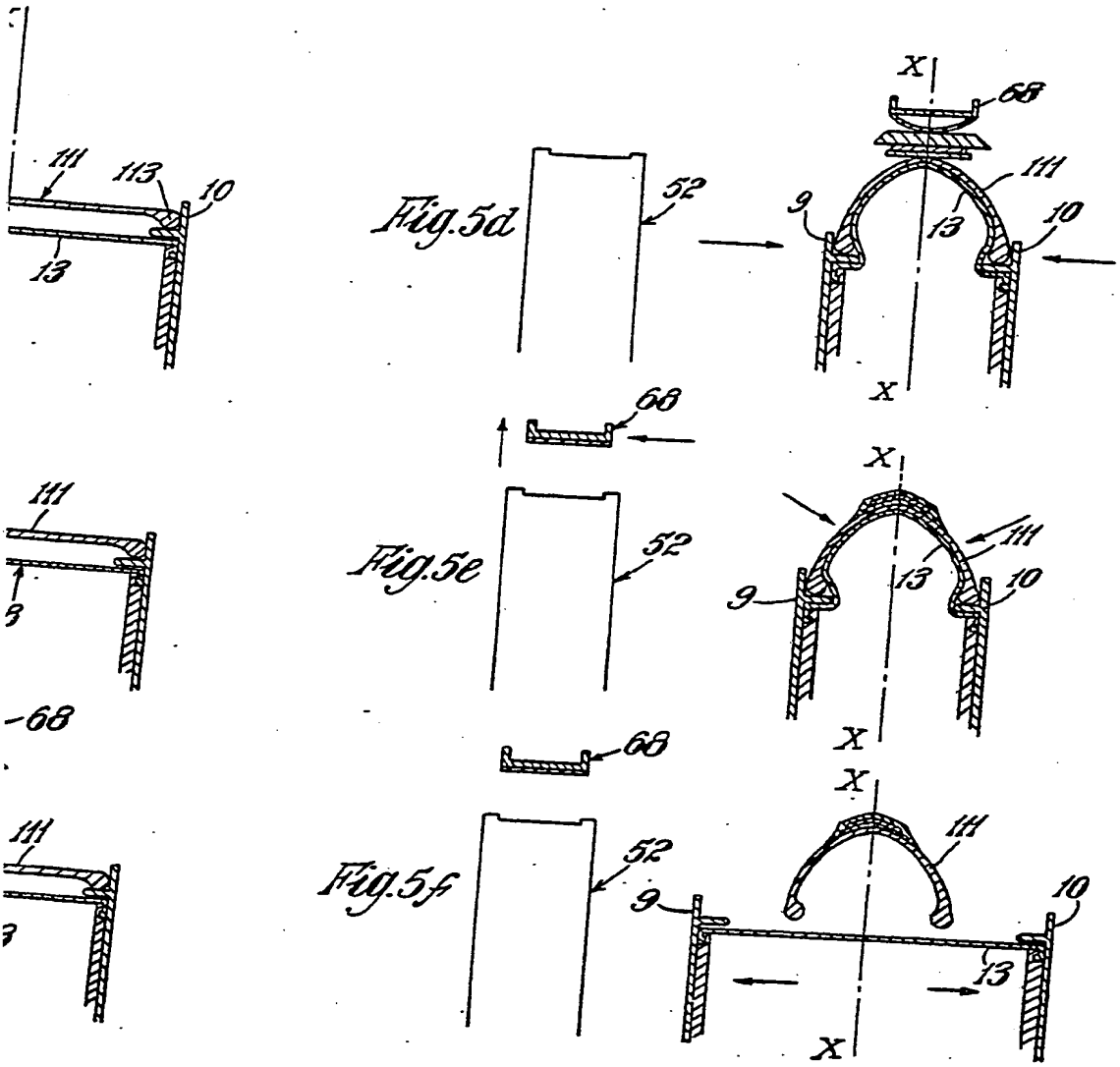
932792 COMPLETE SPECIFICATION
7 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 4 & 5



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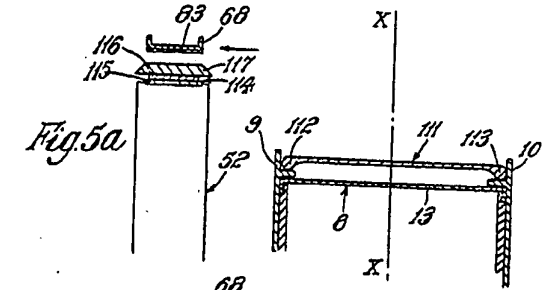

Fig.5a

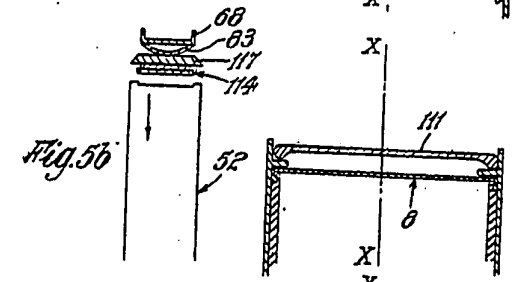

Fig.5b

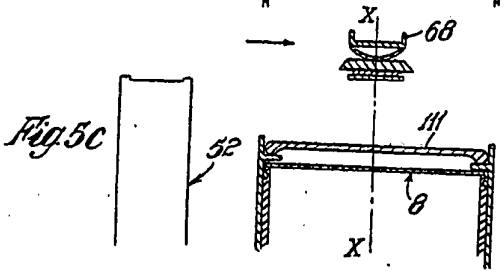

Fig.5c

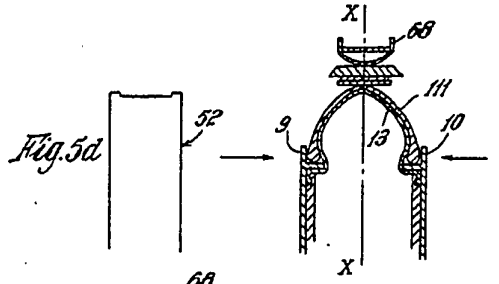

Fig.5d

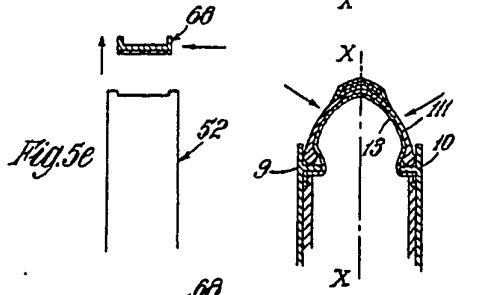

Fig.5e

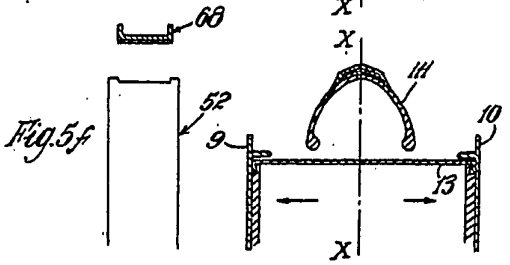

Fig.5f

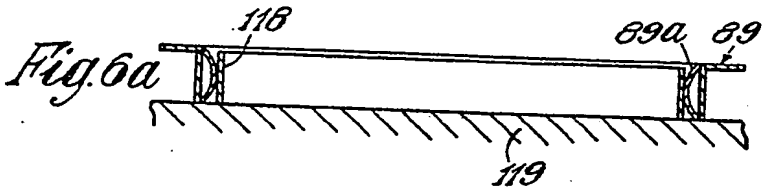

Fig.6a

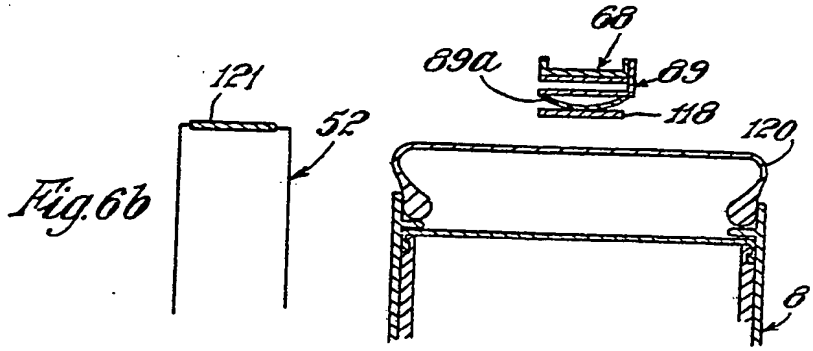

Fig.6b

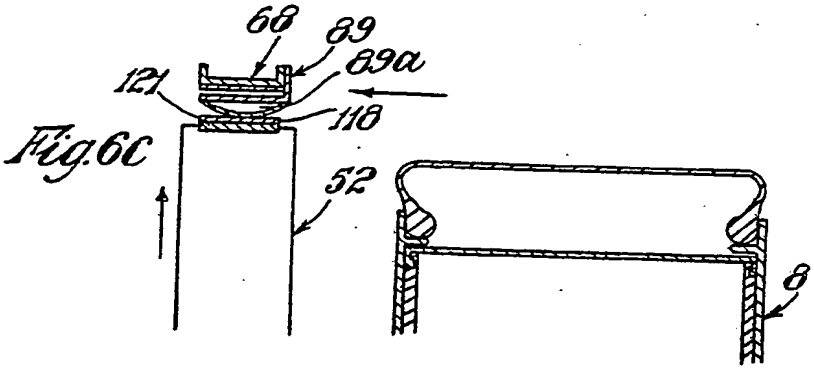

Fig.6c

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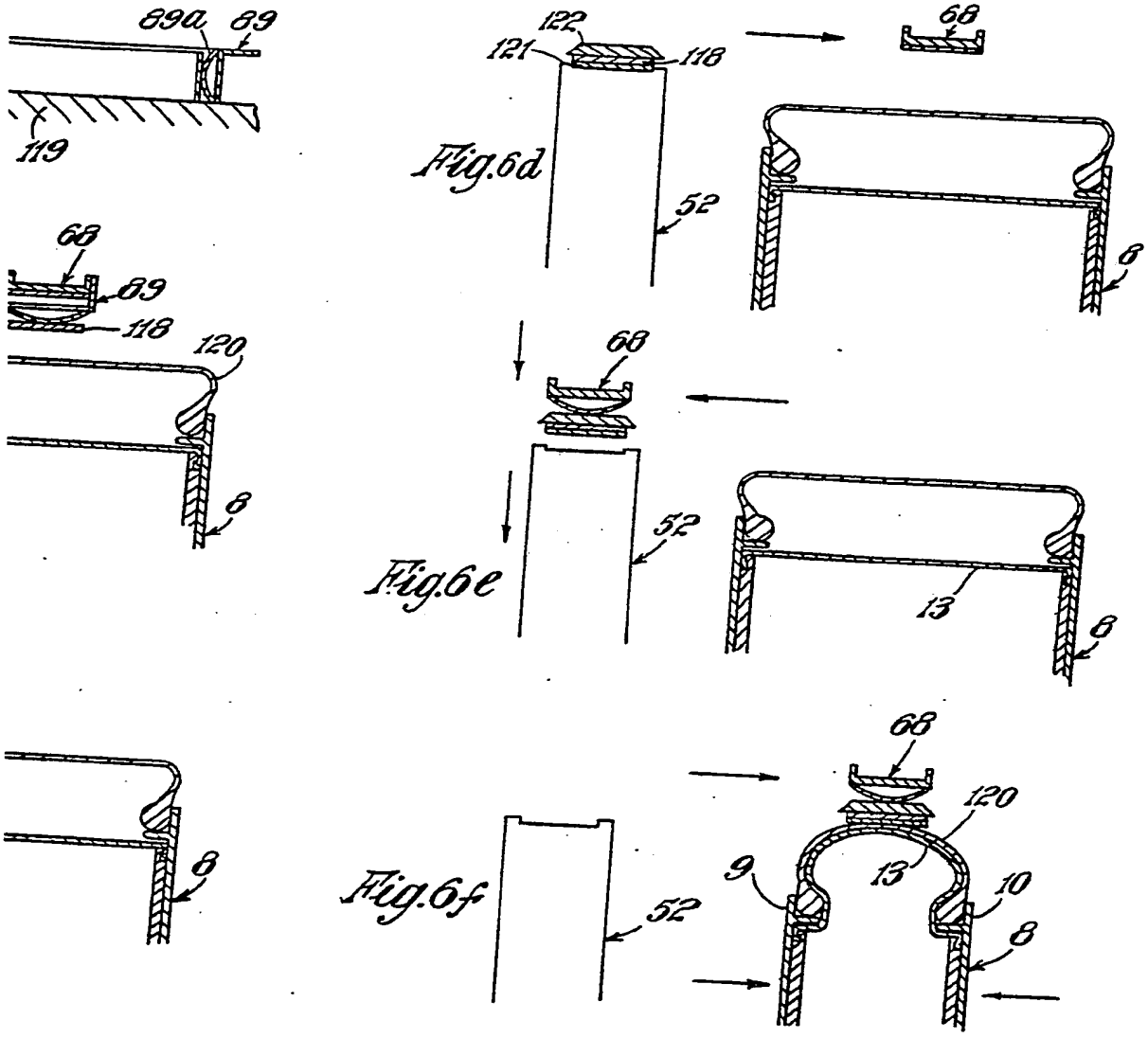

Fig.6d

Fig.6e

Fig.6f

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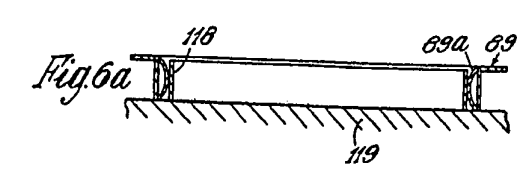
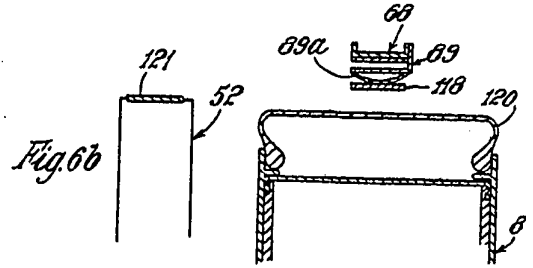


Fig.6a



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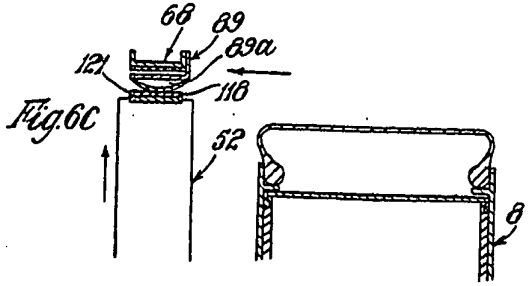


Fig.6c

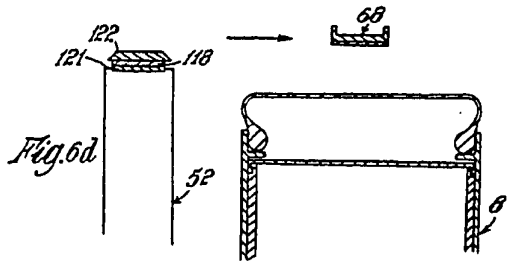
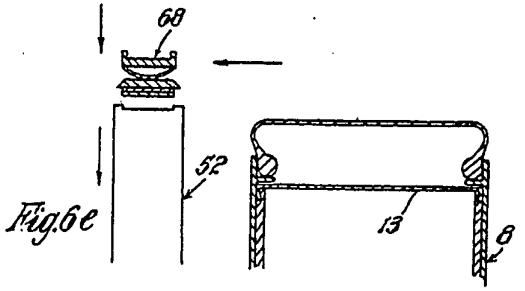


Fig.6d



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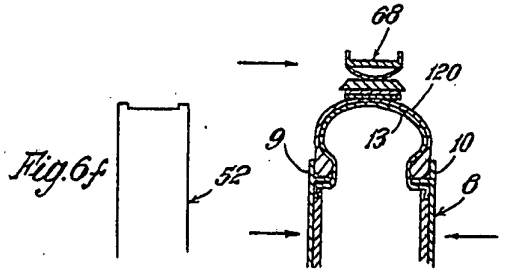

Fig.6f

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